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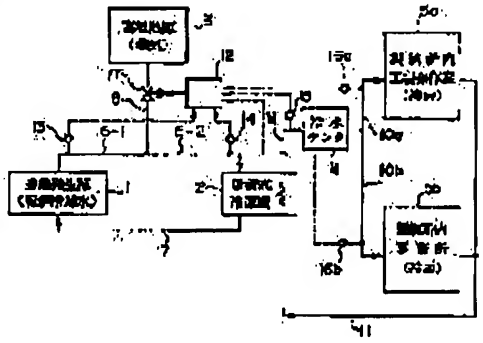
(54) RECOVERING METHOD OF LOW-TEMPERATURE WASTE HEAT GENERATED BY IRON MAKING PROCESS

(57)Abstract:
PROBLEM TO BE SOLVED: To recover low-temperature waste heat efficiently, by a method wherein an adsorption type refrigerating machine, capable of being driven by low-temperature waste heat lower than a specified temperature, is provided at the vicinity of a low-temperature waste heat generating source to generate cold water by driving the machine by the low-temperature waste heat, while the amount of heat is compensated by a high-temperature heat source upon deteriorating the amount of the low-temperature waste heat and generated cold water is reserved once.
SOLUTION: When an adsorption type refrigerating machine 2, capable of being driven by a low-temperature heat source of lower than 100° C, is employed and heat source water maintains a predetermined temperature, cold water of a predetermined temperature is produced stably by employing only the cooling water of the waste heat generating source 1 as heat source. When the temperature of the heat source water is lower than the predetermined temperature, a cold water tank 4 is provided so that a cold water temperature will not be raised suddenly even when the operation of the adsorption type refrigerating machine 2 is stopped. When the cold water temperature is raised gradually and has exceeded the predetermined temperature even when the cold water tank 4 is provided, the amount of heat is compensated by a high-temperature heat source 3 to raise the temperature of the heat source water to the predetermined temperature and the operation of adsorption type refrigerating machine is reopened to output the cold water. According to this method, cold water, having a constant temperature at all times, can be outputted by the necessary minimum heat compensation regardless to the temperature change and the period of the same of the heat source water.



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CLAIMS

[Claim(s)]
[Claim 1]It is the method of collecting low temperature exhaust heat with a temperature of 100 ** or less generated from an iron making process, While considering it as a method which installs an adsorption equation freezer which can be driven with said low temperature exhaust heat near the low-temperature-exhaust-heat source of release concerned, makes this adsorption equation freezer drive with said low temperature exhaust heat, and generates chilled water, A recovery method of low temperature exhaust heat generated from an iron making process characterized by being made to perform quantity-of-heat compensation in a high temperature heat source at the time of a quantity-of-heat fall of said low temperature exhaust heat, and making chilled water by which it was generated once store water on a tank etc.

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DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention]This invention relates to the method of collecting efficiently the low temperature exhaust heat generated from an iron making process.
[0002]
[Description of the Prior Art]About around 1000 ** hot sensible heat, recovery use is carried out by introduction of large-scale exhaust heat recovery power generation etc. among the exhaust heat generated from an iron making process. Recovery use is possible by the binary power generation and the absorption refrigerator which, on the other hand, used the low-boiling point medium about the thing of the relatively high temperature which exceeds 100 ** also about exhaust heat of the low temperature of cooling water etc. However, in the binary power generation by the low-boiling point medium in the case of collecting as electric power, although large-scale equipment of a collection system, power generation equipment, etc. is needed, it is hard to say that generation efficiency is as low as about 10%, and it excels in economical efficiency. In using 100 ** or less of 60-80 ** heat sources for obtaining chilled water using an absorption refrigerator especially, So that clearly from the coefficient of performance of the absorption refrigerator shown in drawing 3, and an adsorption equation freezer, It compares with an adsorption equation freezer and a coefficient of performance (COP) falls extremely, it is inefficient and the exhaust heat further generated from an iron making process does not have the constant conditions of exhaust heat depending on operation of the process of a source of release in many cases, and since the output obtained is changed with operation of a source-of-release process, a use place is limited. For this reason, the absorption refrigerator which makes the steam produced by burning fuel by the electric air-conditioner or a boiler a drive heat source is used for air conditioning of each part store in an iron mill.
[0003]
[Problem(s) to be Solved by the Invention]As mentioned above, when collecting the low temperature exhaust heat 100 ** or less generated from an iron making process as chilled water, and a low thing and the exhaust heat collected receive the influence of operation of the process of a source of release and exhaust heat temperature is changed, Since the efficiency of a device falls substantially and stable use cannot be performed, there is a problem that exhaust heat recovery does not progress. Since the exhaust heat source of release and chilled water use part in an iron mill are not necessarily close, in supplying chilled water to two or more use places, piping etc. take a large amount of installation cost, and it is difficult for change of chilled water load to also collect and use exhaust heat effectively efficiently for a certain reason.
[0004]It was made in order that this invention might solve the above-mentioned conventional problem, and it is going to propose the recovery method of the low temperature exhaust heat in which the thing which occur from an iron making process, and for which it is stabilized and 100 ** or less of 60-80 ** low temperature exhaust heat is collected especially efficiently is possible.
[0005]
[Means for Solving the Problem]While this invention uses 100 ** or less and an adsorption equation freezer which can drive even 60-100 ** low temperature exhaust heat especially in collecting exhaust heat generated from an iron making process, It is a collection system which can generate chilled water efficiently by installing a freezer near the low-temperature-exhaust-heat source of release, While making the gist into a method which installs an adsorption equation freezer which can be driven with said low temperature exhaust heat 100 ** or less near the low-temperature-exhaust-heat source of release concerned, makes this adsorption equation freezer drive with said low temperature exhaust heat, and generates chilled water, At the time of a quantity-of-heat fall of said low temperature exhaust heat, it is made to perform quantity-of-heat compensation in a high temperature heat source, and chilled water by which it was generated was made to once store water on a tank etc.
[0006]An adsorption equation freezer currently generally used conventionally is a freezer which uses ********** accompanying a reversible reaction between a solid adsorbent (for example, silica system) and a refrigerant (water), and generates cold energy by making warm temperature into a heat source, It is the thing a basic cycle consisted of a regeneration process and an adsorption process, changes two sets of solid-adsorbent heat exchangers by turns, and this process was made to operate, It comprises a solid-adsorbent heat exchanger specifically stored by vacuum housing, warm water for reproduction; cooling water for adsorption and a condenser, an evaporator, a chilled water load system and a cooling water subsystem for condensation, four steam valves and selector valves for water, steam pipings, etc. In such an adsorption equation freezer, 75 ** warm water is used, for example for a drive heat source, and cooling water for condensation whose inlet temperature is about 29 ** is used, 9 ** chilled water is obtained from 14 ** chilled water, and, as for a coefficient of performance in that case, about 0.60 value is obtained. A coefficient of performance at the time of incidentally using 75 ** warm water for a drive heat source of an absorption refrigerator is as low as 0.4 or less. Therefore, in this invention, we decided to use an adsorption equation freezer which can compare with the conventional absorption refrigerator and can also drive low-temperature exhaust heat more for a recovery means of the 60-100 ** low temperature exhaust heat generated from an iron making process.
[0007]In this invention, installing an adsorption equation freezer near the low-temperature-exhaust-heat source of release and the bottom are for aiming at reduction of energy loss under transportation of a low-temperature heat source, and reduction of installation costs, such as piping. And at the time of a quantity-of-heat fall of said low temperature exhaust heat, it was made to perform quantity-of-heat compensation in a high temperature heat source in

order to always obtain a fixed output corresponding to change of exhaust heat conditions and to generate chilled water regularly. As a high temperature heat source, a steam generated, for example in an iron mill can be used here. Chilled water by which it was generated was made to once store water on a tank etc. because it enabled it to correspond to change of cooling load by supplying change and two or more use places of exhaust heat conditions under influence of operation of an exhaust heat source of release in order to be able to supply chilled water to two or more use places.
[0008]
[Embodiment of the Invention]Drawing 1 is a schematic diagram showing one example of the low-temperature-exhaust-heat collection system concerning this invention, 1 an exhaust heat source of release (converter cooling water) and 2 an adsorption equation freezer and 3 A high temperature heat source (steam), As for 4, the factory operation room in an iron mill (cooling load) and 5b a cold water tank and 5a The administration building in an iron mill (cooling load), 6-1 an exhaust heat lead pipe and 6-2 the heat source lead pipe for a freezer drive, and 7 The freezer appearance side exhaust heat lead pipe, As for 8, a freezer output chilled water lead pipe, and 10a and 10b a high temperature heat source supply lead pipe and 9 A chilled water supply lead pipe, 11 returns and, as for output cold water temperature and a flow element, and 15, as for cold water temperature and an amount-of-water detector, and 16a and 16b, the control device for quantity-of-heat compensation and 13 are [supply cold water temperature and a flow element, and 17] vapor flow rate control valves exhaust heat hot water temperature and a flow element, and 14 a chilled water lead pipe and 12.
[0009]The cooling water obtained by using the converter cooling water of the exhaust heat source of release 1 for the above-mentioned low-temperature-exhaust-heat collection system as a drive heat source of the adsorption equation freezer 2 which obtains chilled water is the example which once stored water to the cold water tank 4, and was used as an object for air conditioning of the factory operation room 5a in an iron mill, and the administration building 5b in an iron mill. As for the temperature of the converter cooling water of the exhaust heat source of release 1, while blowing with a converter is performed, temperature of effluent rises, and while blowing is not performed, temperature of effluent falls. Falling to an ordinary temperature grade, when prolonged blowing is not performed A certain sake, Exhaust heat hot water temperature and the flow element 13 to the exhaust heat lead pipe 6-1 at the heat source lead pipe 6-2 for a freezer drive output cold water temperature and the flow element 14, Temperature and the flow elements 13 and 14 are formed in the freezer output chilled water lead pipe 9 at cold water temperature, the amount-of-water detector 15, and the chilled water supply lead pipes 10a and 10b, respectively, and it has become a system which controls the quantity-of-heat compensation by the high temperature heat source 3 by the control device 12 for quantity-of-heat compensation so that a fixed chilled water output is always obtained. [the composition by which the exhaust heat which came out of the adsorption equation freezer 2 is returned to the exhaust heat source of release 1 via the freezer appearance side exhaust heat lead pipe 7, and the cyclic use of waste water is carried out and nothing], The chilled water used in the factory operation room 5a in an iron mill and the administration building 5b in an iron mill is constituted so that it may be returned to the adsorption equation freezer 2 and the cyclic use of waste water may be carried out with the return chilled water lead pipe 11.
[0010]
[Example]The low-temperature-exhaust-heat collection system shown in drawing 1 performed air conditioning of the factory operation room 5a in an iron mill, and the administration building 5b in an iron mill. The temporal change of the converter circulating water temperature at that time is shown in drawing 2. While blowing with a converter is performed, temperature of effluent rises, when temperature of effluent falls and prolonged blowing is not performed while blowing is not performed, may fall to an ordinary temperature grade, as shown in drawing 2, but. By having used the adsorption equation freezer 2 which can be driven also in a low-temperature heat source in this invention, it is the rated heat source temperature of this freezer 75 ** The operation minimum temperature could be 60 **. When heat-source-water temperature was maintaining not less than 60 **, it was stabilized only considering converter cooling water as a heat source, and 9 ** chilled water was able to be made. The adsorption equation freezer 2 is set up start operation, if operation is suspended automatically and temperature rises at not less than 65 **, when heat-source-water temperature is less than 60 **.
[0011]When heat-source-water temperature is less than 60 **, as it is, operation stops a freezer automatically, and since cold water temperature rises gradually, it becomes impossible to continue air conditioning by chilled water. However, since the cold water tank is provided in this invention, even if operation of the adsorption equation freezer 2 stops, cold water temperature does not rise rapidly. Since cold water temperature still rises gradually when the interval of blowing of a converter is long (refer to arrow [in drawing 2] A), The cold water temperature and the amount-of-water detector 15 formed in the freezer output chilled water lead pipe 9 detect cold water temperature; If cold water temperature exceeds 10 **, the vapor flow rate control valve 17 will be controlled by the control device 12 for quantity-of-heat compensation so that the heat-source-water temperature of the heat source lead pipe 6-2 for a freezer drive will be 65 **, and quantity-of-heat compensation by the high temperature heat source 3 is performed (refer to arrow [in drawing 2] B). Thereby, the temperature of freezer heat source water rises to 65 **, and the adsorption equation freezer 2 resumes operation and outputs chilled water. If the temperature detected by the exhaust heat hot water temperature and the flow element 13 formed in the exhaust heat lead pipe 6-1 exceeds 65 **, the vapor flow rate control valve 17 will be closed with the control device 12 for quantity-of-heat compensation, and the heat compensation by the high temperature heat source 3 will be stopped. Thereby, the fixed chilled water output was always able to be obtained by necessary minimum heat compensation irrespective of the temperature change of the heat source water by operation of an exhaust heat source of release, and the merits and demerits of a cycle.
[0012]The chilled water [preset temperature / in this case / each] initial complement according to the performance of an adsorption equation freezer, and cooling load, and cold water temperature, it is determined from the temperature change of an exhaust heat source and its cycle, and the steam condition further for quantity-of-heat compensation, and by the situation of the heat source used actually, a freezer, and cooling load, it is set up, respectively and a freezer can be economically operated by heat compensation of a necessary minimum vapor amount.
[0013]
[Effect of the Invention]As explained above, according to this invention method, the effect indicated below is done so.
(1) By having compared with the absorption refrigerator, and having used the adsorption equation freezer which can also drive low-temperature exhaust heat more in the recovery method of iron making process exhaust heat, and having installed this freezer near the exhaust heat source of release, The energy of low temperature exhaust heat can be efficiently used effectively by little investment by the ability reducing the energy loss under exhaust heat source

transportation, and reduce the plant-and-equipment investment to the recovery lead pipe which accounts for a big rate in an exhaust heat recovery facility.
(2) Since quantity-of-heat compensation can be carried out in a hot heat source like the steam which can be easily taken out in the iron mill at the time of the quantity-of-heat fall of low temperature exhaust heat, corresponding to change of the exhaust heat conditions by process operation of an exhaust heat source of release, a fixed output can always be obtained, and chilled water can be generated regularly.
(3) Since it can respond to change of the cooling load by supplying the change and two or more use places of exhaust heat conditions under the influence of operation of an exhaust heat source of release while being able to supply chilled water to two or more use places, it is stabilized at two or more use places in a necessary minimum quantity-of-heat compensation, and chilled water can be supplied.
(4) Energy saving is aimed at by the amount of the electric power or fuel used for air conditioning of each part stores, such as an administration building in an iron mill, or the steam used being reducible.

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TECHNICAL FIELD

[Field of the Invention]This invention relates to the method of collecting efficiently the low temperature exhaust heat generated from an iron making process.

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PRIOR ART

[Description of the Prior Art]About around 1000 ** hot sensible heat, recovery use is carried out by introduction of large-scale exhaust heat recovery power generation etc. among the exhaust heat generated from an iron making process. Recovery use is possible by the binary power generation and the absorption refrigerator which, on the other hand, used the low-boiling point medium about the thing of the relatively high temperature which exceeds 100 ** also about exhaust heat of the low temperature of cooling water etc. However, in the binary power generation by the low-boiling point medium in the case of collecting as electric power, although large-scale equipment of a collection system, power generation equipment, etc. is needed, it is hard to say that generation efficiency is as low as about 10%, and it excels in economical efficiency. In using 100 ** or less of 60-80 ** heat sources for obtaining chilled water using an absorption refrigerator especially, So that clearly from the coefficient of performance of the absorption refrigerator shown in drawing 3, and an adsorption equation freezer, It compares with an adsorption equation freezer and a coefficient of performance (COP) falls extremely, it is inefficient and the exhaust heat further generated from an iron making process does not have the constant conditions of exhaust heat depending on operation of the process of a source of release in many cases, and since the output obtained is changed with operation of a source-of-release process, a use place is limited. For this reason, the absorption refrigerator which makes the steam produced by burning fuel by the electric air-conditioner or a boiler a drive heat source is used for air conditioning of each part store in an iron mill.

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EFFECT OF THE INVENTION

[Effect of the Invention]As explained above, according to this invention method, the effect indicated below is done so.
(1) By having compared with the absorption refrigerator, and having used the adsorption equation freezer which can also drive low-temperature exhaust heat more in the recovery method of iron making process exhaust heat, and having installed this freezer near the exhaust heat source of release, The energy of low temperature exhaust heat can be efficiently used effectively by little investment by the ability reducing the energy loss under exhaust heat source transportation, and reduce the plant-and-equipment investment to the recovery lead pipe which accounts for a big rate in an exhaust heat recovery facility.
(2) Since quantity-of-heat compensation can be carried out in a hot heat source like the steam which can be easily taken out in the iron mill at the time of the quantity-of-heat fall of low temperature exhaust heat, corresponding to change of the exhaust heat conditions by process operation of an exhaust heat source of release, a fixed output can always be obtained, and chilled water can be generated regularly.
(3) Since it can respond to change of the cooling load by supplying the change and two or more use places of exhaust heat conditions under the influence of operation of an exhaust heat source of release while being able to supply chilled water to two or more use places, it is stabilized at two or more use places in a necessary minimum quantity-of-heat compensation, and chilled water can be supplied.
(4) Energy saving is aimed at by the amount of the electric power or fuel used for air conditioning of each part stores, such as an administration building in an iron mill, or the steam used being reducible.

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TECHNICAL PROBLEM

[Problem(s) to be Solved by the Invention]As mentioned above, when collecting the low temperature exhaust heat 100 ** or less generated from an iron making process as chilled water, and a low thing and the exhaust heat collected receive the influence of operation of the process of a source of release and exhaust heat temperature is changed, Since the efficiency of a device falls substantially and stable use cannot be performed, there is a problem that exhaust heat recovery does not progress. Since the exhaust heat source of release and chilled water use part in an iron mill are not necessarily close, in supplying chilled water to two or more use places, piping etc. take a large amount of installation cost, and it is difficult for change of chilled water load to also collect and use exhaust heat effectively efficiently for a certain reason.
[0004]It was made in order that this invention might solve the above-mentioned conventional problem, and it is going to propose the recovery method of the low temperature exhaust heat in which the thing which occur from an iron making process, and for which it is stabilized and 100 ** or less of 60-80 ** low temperature exhaust heat is collected especially efficiently is possible.

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MEANS

[Means for Solving the Problem]While this invention uses 100 ** or less and an adsorption equation freezer which can drive even 60-100 ** low temperature exhaust heat especially in collecting exhaust heat generated from an iron making process, It is a collection system which can generate chilled water efficiently by installing a freezer near the low-temperature-exhaust-heat source of release, While making the gist into a method which installs an adsorption equation freezer which can be driven with said low temperature exhaust heat 100 ** or less near the low-temperature-exhaust-heat source of release concerned, makes this adsorption equation freezer drive with said low temperature exhaust heat, and generates chilled water, At the time of a quantity-of-heat fall of said low temperature exhaust heat, it is made to perform quantity-of-heat compensation in a high temperature heat source, and chilled water by which it was generated was made to once store water on a tank etc.

[0006]An adsorption equation freezer currently generally used conventionally is a freezer which uses ********** accompanying a reversible reaction between a solid adsorbent (for example, silica system) and a refrigerant (water), and generates cold energy by making warm temperature into a heat source, It is the thing a basic cycle consisted of a regeneration process and an adsorption process, changes two sets of solid-adsorbent heat exchangers by turns, and this process was made to operate, It comprises a solid-adsorbent heat exchanger specifically stored by vacuum housing, warm water for reproduction, cooling water for adsorption and a condenser, an evaporator, a chilled water load system and a cooling water subsystem for condensation, four steam valves and selector valves for water, steam pipings, etc. In such an adsorption equation freezer, 75 ** warm water is used, for example for a drive heat source, and cooling water for condensation whose inlet temperature is about 29 ** is used, 9 ** chilled water is obtained from 14 ** chilled water, and, as for a coefficient of performance in that case, about 0.60 value is obtained. A coefficient of performance at the time of incidentally using 75 ** warm water for a drive heat source of an absorption refrigerator is as low as 0.4 or less. Therefore, in this invention, we decided to use an adsorption equation freezer which can compare with the conventional absorption refrigerator and can also drive low-temperature exhaust heat more for a recovery means of the 60-100 ** low temperature exhaust heat generated from an iron making process.

[0007]In this invention, installing an adsorption equation freezer near the low-temperature-exhaust-heat source of release and the bottom are for aiming at reduction of energy loss under transportation of a low-temperature heat source, and reduction of installation costs, such as piping. And at the time of a quantity-of-heat fall of said low temperature exhaust heat, it was made to perform quantity-of-heat compensation in a high temperature heat source in order to always obtain a fixed output corresponding to change of exhaust heat conditions and to generate chilled water regularly. As a high temperature heat source, a steam generated, for example in an iron mill can be used here. Chilled water by which it was generated was made to once store water on a tank etc. because it enabled it to correspond to change of cooling load by supplying change and two or more use places of exhaust heat conditions under influence of operation of an exhaust heat source of release in order to be able to supply chilled water to two or more use places.

[0008]

[Embodiment of the Invention]Drawing 1 is a schematic diagram showing one example of the low-temperature-exhaust-heat collection system concerning this invention, 1 an exhaust heat source of release (converter cooling water) and 2 an adsorption equation freezer and 3 A high temperature heat source (steam), As for 4, the factory operation room in an iron mill (cooling load) and 5b a cold water tank and 5a The administration building in an iron mill (cooling load), 6-1 an exhaust heat lead pipe and 6-2 the heat source lead pipe for a freezer drive, and 7 The freezer appearance side exhaust heat lead pipe, As for 8, a freezer output chilled water lead pipe, and 10a and 10b a high temperature heat source supply lead pipe and 9 A chilled water supply lead pipe, 11 returns and, as for output cold water temperature and a flow element, and 15, as for cold water temperature and an amount-of-water detector, and 16a and 16b, the control device for quantity-of-heat compensation and 13 are [supply cold water temperature and a flow element, and 17] vapor flow rate control valves exhaust heat hot water temperature and a flow element, and 14 a chilled water lead pipe and 12.

[0009]The cooling water obtained by using the converter cooling water of the exhaust heat source of release 1 for the above-mentioned low-temperature-exhaust-heat collection system as a drive heat source of the adsorption equation freezer 2 which obtains chilled water is the example which once stored water to the cold water tank 4, and was used as an object for air conditioning of the factory operation room 5a in an iron mill, and the administration building 5b in an iron mill. As for the temperature of the converter cooling water of the exhaust heat source of release 1, while blowing with a converter is performed, temperature of effluent rises, and while blowing is not performed, temperature of effluent falls. Falling to an ordinary temperature grade, when prolonged blowing is not performed A certain sake, Exhaust heat hot water temperature and the flow element 13 to the exhaust heat lead pipe 6-1 at the heat source lead pipe 6-2 for a freezer drive output cold water temperature and the flow element 14, Temperature and the flow elements 13 and 14 are formed in the freezer output chilled water lead pipe 9 at cold water temperature, the amount-of-water detector 15, and the chilled water supply lead pipes 10a and 10b, respectively, and it has become a system which controls the quantity-of-heat compensation by the high temperature heat source 3 by the control device 12 for quantity-of-heat compensation so that a fixed chilled water output is always obtained. [the composition by which the exhaust heat which came out of the adsorption equation freezer 2 is returned to the exhaust heat source of release 1 via the freezer appearance side exhaust heat lead pipe 7, and the cyclic use of waste water is carried out and nothing], The chilled water used in the factory operation room 5a in an iron mill and the administration building 5b in an iron mill is constituted so that it may be returned to the adsorption equation freezer 2 and the cyclic use of waste water may be carried out with the return chilled water lead pipe 11.

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EXAMPLE

[Example]The low-temperature-exhaust-heat collection system shown in drawing 1 performed air conditioning of the factory operation room 5a in an iron mill, and the administration building 5b in an iron mill. The temporal change of the converter circulating water temperature at that time is shown in drawing 2. While blowing with a converter is performed, temperature of effluent rises, when temperature of effluent falls and prolonged blowing is not performed while blowing is not performed, may fall to an ordinary temperature grade, as shown in drawing 2, but. By having used the adsorption equation freezer 2 which can be driven also in a low-temperature heat source in this invention, it is the rated heat source temperature of this freezer 75 ** The operation minimum temperature could be 60 **. When heat-source-water temperature was maintaining not less than 60 **, it was stabilized only considering converter cooling water as a heat source, and 9 ** chilled water was able to be made. The adsorption equation freezer 2 is set up start operation, if operation is suspended automatically and temperature rises at not less than 65 **, when heat-source-water temperature is less than 60 **.
[0011]When heat-source-water temperature is less than 60 **, as it is, operation stops a freezer automatically, and since cold water temperature rises gradually, it becomes impossible to continue air conditioning by chilled water. However, since the cold water tank is provided in this invention, even if operation of the adsorption equation freezer 2 stops, cold water temperature does not rise rapidly. Since cold water temperature still rises gradually when the interval of blowing of a converter is long (refer to arrow [in drawing 2] A), The cold water temperature and the amount-of-water detector 15 formed in the freezer output chilled water lead pipe 9 detect cold water temperature. If cold water temperature exceeds 10 **, the vapor flow rate control valve 17 will be controlled by the control device 12 for quantity-of-heat compensation so that the heat-source-water temperature of the heat source lead pipe 6-2 for a freezer drive will be 65 **, and quantity-of-heat compensation by the high temperature heat source 3 is performed (refer to arrow [in drawing 2] B). Thereby, the temperature of freezer heat source water rises to 65 **, and the adsorption equation freezer 2 resumes operation and outputs chilled water. If the temperature detected by the exhaust heat hot water temperature and the flow element 13 formed in the exhaust heat lead pipe 6-1 exceeds 65 **, the vapor flow rate control valve 17 will be closed with the control device 12 for quantity-of-heat compensation, and the heat compensation by the high temperature heat source 3 will be stopped. Thereby, the fixed chilled water output was always able to be obtained by necessary minimum heat compensation irrespective of the temperature change of the heat source water by operation of an exhaust heat source of release, and the merits and demerits of a cycle.
[0012]The chilled water [preset temperature / in this case / each] initial complement according to the performance of an adsorption equation freezer, and cooling load, and cold water temperature. It is determined from the temperature change of an exhaust heat source and its cycle, and the steam condition further for quantity-of-heat compensation, and by the situation of the heat source used actually, a freezer, and cooling load, it is set up, respectively and a freezer can be economically operated by heat compensation of a necessary minimum vapor amount.

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DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1]It is a schematic diagram showing one example of the low-temperature-exhaust-heat collection system concerning this invention.
[Drawing 2]It is a figure showing an example of the temporal change of the converter circulating water temperature in the example of this invention.
[Drawing 3]It is a figure comparing and showing an example of the coefficient of performance of an absorption refrigerator and an adsorption equation freezer.
[Description of Notations]
1 Exhaust heat source of release (converter cooling water)
2 Adsorption equation freezer
3 High temperature heat source (steam)
4 Cold water tank
5a The factory operation room in an iron mill (cooling load)
5b The administration building in an iron mill (cooling load)
6-1 Exhaust heat lead pipe
6-2 The heat source lead pipe for a freezer drive
7 Freezer appearance side exhaust heat lead pipe
8 High temperature heat source supply lead pipe
9 Freezer output chilled water lead pipe
10a and 10b Chilled water supply lead pipe
11 Return chilled water lead pipe
12 A control device for quantity-of-heat compensation
13 Exhaust heat hot water temperature and a flow element
14 Output cold water temperature and a flow element
15 Cold water temperature and an amount-of-water detector
16a and 16b Supply cold water temperature and flow element
17 Vapor flow rate control valve

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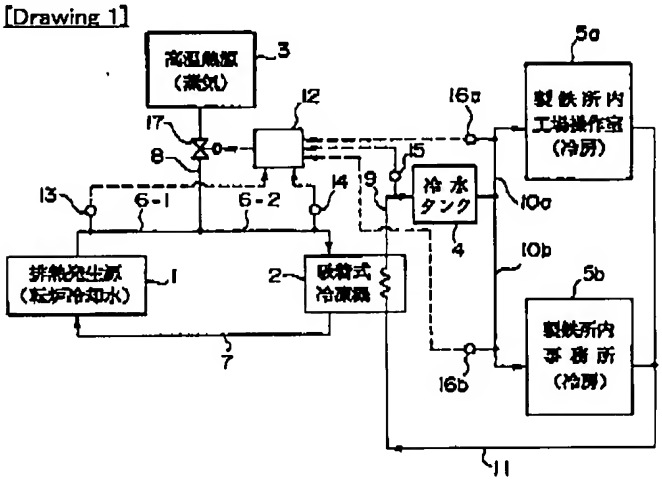
3.In the drawings, any words are not translated.

DRAWINGS

[Drawing 1]



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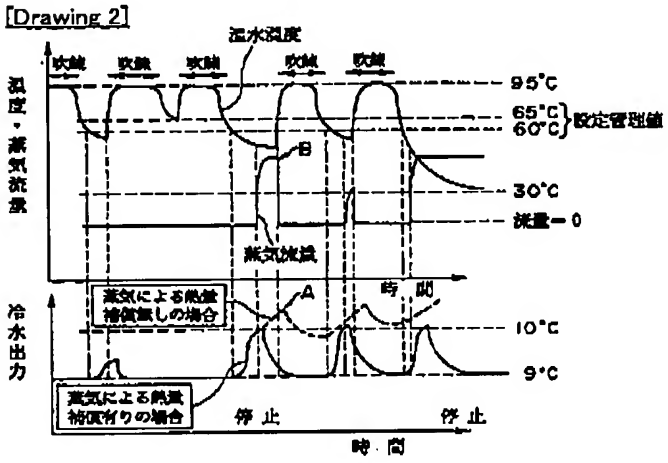
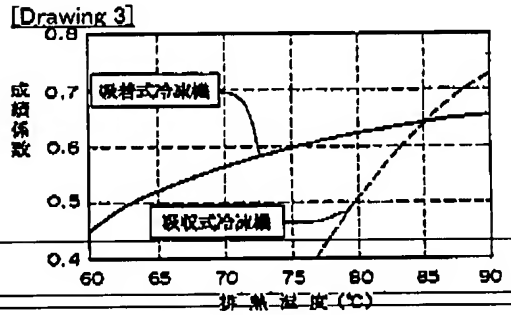


[Drawing 3]



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(54)【発明の名称】　製鉄プロセスから発生する低温排熱の回収方法

(57)【要約】

【課題】　製鉄プロセスから発生する１００℃以下の低温排熱を安定して効率よく回収する方法の提案。

【解決手段】　製鉄プロセスから発生する温度１００℃以下の低温排熱にて駆動可能な吸着式冷凍機を当該低温排熱発生源の近傍に設置し、該吸着式冷凍機を前記低温排熱により駆動させて冷水を発生させる方式とするとともに、前記低温排熱の熱量低下時には高温熱源にて熱量補償を行うようにし、かつ発生した冷水をいったんタンク等に貯水するようにしたことを特徴とする。

【効果】　少ない投資で効率よく低温排熱のエネルギーを有効利用することができる。排熱発生源のプロセス操業による排熱条件の変動に対応して常時一定の出力を得て定常的に冷水を発生させることができる。必要最小限の熱量補償で複数の使用先に安定して冷水を供給することができる。省エネルギーがはかられる。

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【特許請求の範囲】

【請求項１】　製鉄プロセスから発生する温度１００℃以下の低温排熱を回収する方法であって、前記低温排熱にて駆動可能な吸着式冷凍機を当該低温排熱発生源の近傍に設置し、該吸着式冷凍機を前記低温排熱により駆動させて冷水を発生させる方式とするとともに、前記低温排熱の熱量低下時には高温熱源にて熱量補償を行うようにし、かつ発生した冷水をいったんタンク等に貯水するようにしたことを特徴とする製鉄プロセスから発生する低温排熱の回収方法。

【発明の詳細な説明】

【０００１】

【発明の属する技術分野】この発明は製鉄プロセスから発生する低温排熱を効率よく回収する方法に関する。

【０００２】

【従来の技術】製鉄プロセスから発生する排熱のうち、１０００℃前後の高温の顕熱については大規模な排熱回収発電等の導入により回収利用されている。一方、冷却水等の低温の排熱についても、１００℃を超える比較的高温のものについては、低沸点媒体を用いたバイナリー発電や吸収式冷凍機により回収利用は可能である。しかしながら、電力として回収する場合の低沸点媒体によるバイナリー発電の場合、回収システムおよび発電設備等の大規模な設備を必要とするわりには、発電効率は１０％程度と低く、経済性に優れるとは言い難い。また、吸収式冷凍機を利用して冷水を得るのに１００℃以下、特に６０～８０℃の熱源を利用する場合には、図３に示す吸収式冷凍機と吸着式冷凍機の成績係数から明らかなごとく、吸着式冷凍機に比し極端に成績係数（ＣＯＰ）が低下し効率が悪く、さらには製鉄プロセスから発生する排熱は発生源のプロセスの操業に依存し、排熱の条件が一定でない場合が多く、得られる出力は発生源プロセスの操業と共に変動するため、利用先が限定される。このため、製鉄所内の各部屋の冷房には、電気エアコンまたはボイラーで燃料を燃焼させて得られる蒸気を駆動熱源とする吸収式冷凍機が使用されている。

【０００３】

【発明が解決しようとする課題】上記のように、製鉄プロセスから発生する１００℃以下の低温排熱を冷水として回収する場合、排熱温度が低いことおよび、回収される排熱が発生源のプロセスの操業の影響を受け変動することにより、装置の効率が大幅に低下し、安定した利用ができないため、排熱回収が進まないという問題がある。また、製鉄所内の排熱発生源と冷水利用箇所は必ずしも近接していないため、複数の利用先へ冷水を供給する場合には配管等に多額の設備費を要し、また冷水負荷の変動もあるために効率的に排熱を回収し有効利用することは困難である。

【０００４】この発明は上記した従来の問題を解決するためになされたもので、製鉄プロセスから発生する１００℃以下、特に６０～８０℃の低温排熱を安定して効率よく回収することが可能な低温排熱の回収方法を提案しようとするものである。

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【０００５】

【課題を解決するための手段】この発明は製鉄プロセスから発生する排熱を回収するにあたり、１００℃以下、特に６０～１００℃の低温排熱でも駆動可能な吸着式冷凍機を用いるとともに、冷凍機を低温排熱発生源の近傍に設置することにより、効率よく冷水を発生させることが可能な回収システムであり、その要旨は前記１００℃以下の低温排熱にて駆動可能な吸着式冷凍機を当該低温排熱発生源の近傍に設置し、該吸着式冷凍機を前記低温排熱により駆動させて冷水を発生させる方式とするとともに、前記低温排熱の熱量低下時には高温熱源にて熱量補償を行うようにし、かつ発生した冷水をいったんタンク等に貯水するようにしたことを特徴とするものである。

【０００６】従来一般に使用されている吸着式冷凍機は、固体吸着剤（例えばシリカ系）と冷媒（水）との間の可逆反応に伴う発吸熱現象を利用し、温熱を熱源として冷熱を発生させる冷凍機で、基本サイクルは再生工程と吸着工程とよりなり、該工程を二基の固体吸着剤熱交換器を交互に切り替え作動するようにしたもので、具体的には真空容器に収納された固体吸着剤熱交換器と、再生用温水と吸着用冷却水、凝縮器と蒸発器、冷水負荷系と凝縮用冷却水系、４個の蒸気弁と水用切替弁、蒸気配管等より構成されている。このような吸着式冷凍機においては、例えば駆動熱源に７５℃の温水を使用し、また入口温度が約２９℃の凝縮用冷却水を使用して、１４℃の冷水より９℃の冷水が得られ、その場合の成績係数は約０．６０の値が得られている。ちなみに吸収式冷凍機の駆動熱源に７５℃の温水を使用した場合の成績係数は０．４以下と低い。したがって、この発明では製鉄プロセスから発生する６０～１００℃の低温排熱の回収手段に、従来の吸収式冷凍機に比しより低温の排熱でも駆動可能な吸着式冷凍機を使用することとしたのである。

【０００７】また、この発明において、吸着式冷凍機を低温排熱発生源の近傍に設置することとしたは、低温熱源の輸送中におけるエネルギー損失の低減と配管等設備費の低減をはかるためである。さらに、かつ前記低温排熱の熱量低下時には高温熱源にて熱量補償を行うようにしたのは、排熱条件の変動に対応して常時一定の出力を得て定常的に冷水を発生させるためである。ここで高温熱源としては、例えば製鉄所内で発生する蒸気を用いることができる。また、発生した冷水をいったんタンク等に貯水するようにしたのは、複数の使用先に冷水を供給できるようにするためと、排熱発生源の操業の影響による排熱条件の変動や複数の使用先に供給することによる冷房負荷の変動に対応できるようにするためである。

【０００８】

3

【発明の実施の形態】図１はこの発明に係る低温排熱回収システムの一実施例を示す概略図であり、１は排熱発生源（転炉冷却水）、２は吸着式冷凍機、３は高温熱源（蒸気）、４は冷水タンク、５ａは製鉄所内工場操作室（冷房負荷）、５ｂは製鉄所内事務所（冷房負荷）、６－１は排熱導管、６－２は冷凍機駆動用熱源導管、７は冷凍機出側排熱導管、８は高温熱源供給導管、９は冷凍機出力冷水導管、１０ａ、１０ｂは冷水供給導管、１１は戻り冷水導管、１２は熱量補償用制御装置、１３は排熱温水温度・流量検出器、１４は出力冷水温度・流量検出器、１５は冷水温度・水量検出器、１６ａ、１６ｂは供給冷水温度・流量検出器、１７は蒸気流量調節弁である。

【０００９】上記の低温排熱回収システムは、冷水を得る吸着式冷凍機２の駆動熱源として排熱発生源１の転炉冷却水を利用し、得られた冷却水はいったん冷水タンク４に貯水し、製鉄所内工場操作室５ａと製鉄所内事務所５ｂの冷房用として使用した例である。排熱発生源１の転炉冷却水の温度は、転炉での吹錬が行われている間は排水温度が上昇し、吹錬が行われない間は排水温度が低下する。また、長時間吹錬が行われない場合には常温程度まで下がることもあるため、排熱導管６－１に排熱温水温度・流量検出器１３を、冷凍機駆動用熱源導管６－２に出力冷水温度・流量検出器１４を、冷凍機出力冷水導管９に冷水温度・水量検出器１５および冷水供給導管１０ａ、１０ｂに温度・流量検出器１３、１４をそれぞれ設け、常時一定の冷水出力が得られるように高温熱源３による熱量補償を熱量補償用制御装置１２により制御するシステムとなっている。なお、吸着式冷凍機２を出た排熱は冷凍機出側排熱導管７を介して排熱発生源１へ戻されて循環使用される構成となし、また製鉄所内工場操作室５ａと製鉄所内事務所５ｂで使用された冷水は戻り冷水導管１１にて吸着式冷凍機２へ戻されて循環使用されるように構成されている。

【００１０】

【実施例】図１に示す低温排熱回収システムにより製鉄所内工場操作室５ａと製鉄所内事務所５ｂの冷房を行った。その時の転炉冷却水温度の時間変化を図２に示す。図２に示す通り、転炉での吹錬が行われている間は排水温度が上昇し、吹錬が行われない間は排水温度が低下し、長時間吹錬が行われない場合には常温程度まで下がることもあるが、この発明では低温熱源でも駆動可能な吸着式冷凍機２を使用したことにより、該冷凍機の定格熱源温度を７５℃、運転最低温度を６０℃とすることができた。熱源水温度が６０℃以上を維持している場合には、転炉冷却水のみを熱源として安定して９℃の冷水を作ることができた。なお、吸着式冷凍機２は熱源水温度が６０℃を下回った場合自動的に運転を停止し、６５℃以上に温度が上昇すると運転を開始するように設定されている。

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【００１１】熱源水温度が６０℃を下回った場合そのままでは冷凍機は自動的に運転が停止し、冷水温度は徐々に上昇するため冷水による冷房を継続することは不可能となる。しかし、本発明では冷水タンクを設けているので、吸着式冷凍機２の運転が停止しても急激に冷水温度が上昇することはない。それでも転炉の吹錬の間隔が長い場合には、冷水温度が徐々に上昇するので（図２中の矢印Ａ参照）、冷凍機出力冷水導管９に設けられた冷水温度・水量検出器１５によって冷水温度を検出し、冷水温度が１０℃を上回ると冷凍機駆動用熱源導管６－２の熱源水温度が６５℃になるように熱量補償用制御装置１２により蒸気流量調節弁１７を制御し、高温熱源３による熱量補償を行う（図２中の矢印Ｂ参照）。これにより、冷凍機熱源水の温度が６５℃まで上昇し、吸着式冷凍機２は運転を再開し冷水を出力する。さらに、排熱導管６－１に設けられた排熱温水温度・流量検出器１３により検出された温度が６５℃を上回ると、熱量補償用制御装置１２により蒸気流量調節弁１７を閉じ、高温熱源３による熱補償を停止する。これにより、排熱発生源の操業による熱源水の温度変化および周期の長短にかかわらず必要最小限の熱補償で常時一定の冷水出力を得ることができた。

【００１２】この際の各々の設定温度は吸着式冷凍機の性能、冷房負荷に応じた冷水必要量および冷水温度、排熱源の温度変化およびその周期、さらには熱量補償用の蒸気条件から決定されるものであり、実際には使用する熱源、冷凍機、冷房負荷の状況によってそれぞれ設定され、必要最小限の蒸気量の熱補償で経済的に冷凍機を運転することができる。

【００１３】

【発明の効果】以上説明したごとく、この発明方法によれば以下に記載する効果を奏する。

（１）製鉄プロセス排熱の回収方法において、吸収式冷凍機に比しより低温の排熱でも駆動可能な吸着式冷凍機を使用し、かつ該冷凍機を排熱発生源の近傍に設置したことにより、排熱源輸送中のエネルギー損失を低減でき、排熱回収設備において大きな割合を占める回収導管への設備投資を低減できることにより、少ない投資で効率よく低温排熱のエネルギーを有効利用することができる。

（２）低温排熱の熱量低下時には同製鉄所内で容易に取り出すことのできる蒸気のような高温の熱源で熱量補償できるので、排熱発生源のプロセス操業による排熱条件の変動に対応して常時一定の出力を得て定常的に冷水を発生させることができる。

（３）複数の使用先に冷水を供給できるとともに、排熱発生源の操業の影響による排熱条件の変動や複数の使用先に供給することによる冷房負荷の変動に対応できるので、必要最小限の熱量補償で複数の使用先に安定して冷水を供給することができる。

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（４）製鉄所内の事務所等の各部屋の冷房に使用される電力あるいは燃料や蒸気の使用量を削減することができることにより、省エネルギーがはかられる。

【図面の簡単な説明】

【図１】この発明に係る低温排熱回収システムの一実施例を示す概略図である。

【図２】この発明の実施例における転炉冷却水温度の時間変化の一例を示す図である。

【図３】吸収式冷凍機と吸着式冷凍機の成績係数の一例を比較して示す図である。

【符号の説明】

１　排熱発生源（転炉冷却水）
２　吸着式冷凍機
３　高温熱源（蒸気）
４　冷水タンク

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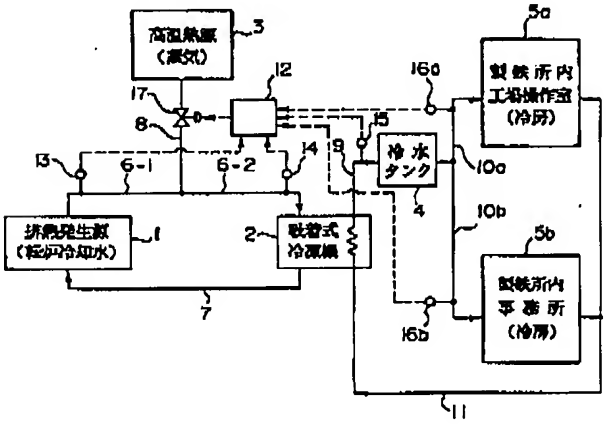
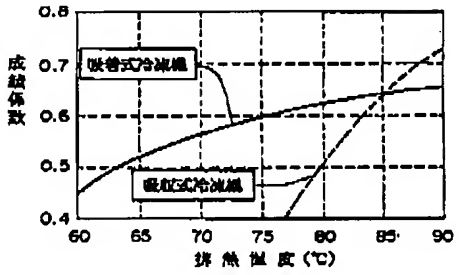
５ａ　製鉄所内工場操作室（冷房負荷）
５ｂ　製鉄所内事務所（冷房負荷）
６－１　排熱導管
６－２　冷凍機駆動用熱源導管
７　冷凍機出側排熱導管
８　高温熱源供給導管
９　冷凍機出力冷水導管
１０ａ、１０ｂ　冷水供給導管
１１　戻り冷水導管
１２　熱量補償用制御装置
１３　排熱温水温度・流量検出器
１４　出力冷水温度・流量検出器
１５　冷水温度・水量検出器
１６ａ、１６ｂ　供給冷水温度・流量検出器
１７　蒸気流量調節弁

【図１】



【図３】



【図２】